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Development of Pulse-Supplemented Wheat Flour to Address Malnutrition

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Malnutrition is an imbalance of nutrients and energy in children and adults. Above 20 million children between the ages of one to five are acutely malnourished, according to the WHO. Foods of plant origin do not provide complete nutrients individually that can promote optimum consumer growth. These food sources may be deficient in one or more essential nutrients for the human body. In Pakistan, wheat is considered a staple food, and most of the population is dependent on wheat as a major source of diet around the year, which results in nutritional deficiencies. Biofortification of food can reduce malnutrition. The current study was designed to produce wheat and pulses (e.g. black gram, green gram, soya bean, and chickpea) composite flour at different concentrations to improve nutritional status. The flour was chemically analyzed for moisture content, crude protein, crude fat, crude fiber, and total phenolic and mineral contents. The higher protein content was examined in soybeans followed by chickpeas, respectively. The higher mineral (potassium) content was found in green grams compared to other pulses. Furthermore, the results indicated that the composite flour significantly increased the nutritional profile. The higher protein and the higher mineral (potassium) content were observed in the T2 treatment. Based on these results, it was concluded that the composite flour can enhance the nutritional profile of pulses.
Keywords: Composite flour, food, malnutrition, pulses, nutritional profile.

INTRODUCTION

Malnutrition results from an individual's diet containing insufficient amounts of certain nutrients or energy, which can lead to undernutrition, overnutrition, an imbalance in nutrients, or deficiencies in particular nutrients (Dukhi, 2020). Malnutrition is a global issue, but it is more prevalent in developing countries. It is directly responsible for the vast majority of mortality in children under the age of five. Similarly, the higher prevalence of stunting, wasting, and underweight contributes to child mortality and illness concerns (Saha *et al*., 2022).

The reasons for not eating a healthy diverse diet are complex and multifactored. However, they include a lack of access to foods, a lack of knowledge on diverse diet composition, cultural norms, traditions, poverty, and food and nutrition governance. International and national level food policy may contribute to the erosion of local crops and varieties that underpin traditional dietary diversity. Many individual crops are locally valuable but are neglected by policymaking. Thus, Dietary Diversity (DD) is internationally recognized as a vital element of healthy diets as it is a measurement of diet quality (Weerasekara *et al*., 2020).

Dietary Diversity (DD) is defined as the number of different food groups or foods consumed in a given period. Diverse foods are a good source for various macro and micronutrients and best ensure nutrient adequacy. Increased risk of chronic diseases and malnutrition are associated with dietary factors, and international and local guidelines recommend improving dietary diversity. Therefore, DD is needed to meet energy requirements and other necessary nutrients, especially for those at risk for nutritional deficiencies and chronic diseases. More so, DD is a key measure of sustainable diets and is currently being considered as one of the principal sustainable diet indicators for the United Nations' Sustainable Development Goals (SDGs) (Ruel, 2003).

Food is a basic need for human beings. However, with time nutritional needs and hunger around the world are increasing

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at a significantly higher pace due to the uprising population, availability of unfertile lands as well and marginally high-priced foods. Around the globe, legumes are considered an excellent source of essential nutrients i.e., minerals, vitamins, and high energy count. Whereas, pulse crops such as soya bean & chickpea were cultivated around several parts of the world and recognized as important sources of both protein and dietary fiber content. On an analysis basis, these crops were analyzed to contain protein, starch, and dietary fiber in the range of 18.50-30, 35-52, and 14.6-26.3 percent, respectively (Duke, 2012).

Generally, the protein content of legumes can be efficaciously utilized in the development of protein-enriched baked derivatives with significantly enhanced essential amino acid profiles. Numerous researches have reported the application of legume protein content in value-added baked derivatives, primarily in the state of composite protein flours. Legumes are mainly made up of dietary fiber which is not digested by the human body in contrast to other food components *i.e.*, protein, fat, carbohydrates, or mineral content that can easily digested (Dahl *et al.*, 2015).

Chickpeas (*Cicer arietinum*) is one of the important pulses and it is also one of the oldest known pulses. The name of the chickpea is derived from the genus name *Cicer*. In the 18th century, the chickpea was known as 'chickpea' in English. In Spanish, it was termed as garbanzo. It is known as Chana in the Indian Subcontinent. Chickpeas (*Cicer arietinum*) is a member of one of the main family of legumes known as the *Fabaceae* family (Sofi *et al.*, 2020).

In Pakistan, locally cultivated cultivars are smaller in size with brown, green, and black. According to numerous scientific ventures reported by researchers, the protein quality of bread, supplemented with dissimilar levels of chickpea flour may affect the rheological profile of dough as well as the final product (Mohammed *et al.*, 2014).

The nutritional profile of the chickpea crop is very powerful. It is rich in proteins, fiber, vitamins, and fat. Chickpea is considered an important and valuable source of dietary fiber, complex carbohydrates, vitamins, and different minerals which are important and valuable for human health. The protein content in the chickpea crop is in the range of 25-28% (Wallace *et al.*, 2016).

Green gram is also known as *Vignaradiata* (L.) Wilczek in South and Southeast Asia this is important and fit for human consumption. In India, this is the third most important crop (Rajiv *et al.*, 2012).

Nutritionally green gram consists of protein and minerals (calcium, iron, magnesium, phosphorus, and potassium), vitamins like thiamine, riboflavin, ascorbic acid, pantothenic acid, niacin, and vitamin A (Bazaz *et al.*, 2016). Growth retardation, anemia, and edema formation will be due to protein and energy deficiency combined which is the reason for death in several children (Scheinfeld *et al.*, 2015).

Soybeans (*Glycine max* L.) are a family of legumes native to East Asia and introduced to Pakistan in the early 1960s. In the initial stages of cultivation, soybeans are primarily grown for their edible seeds (Ahsan *et al.*, 2019). Soybean is recognized as the most significant bean around the globe due to its significantly higher concentrations of protein content along with an abundance of bioactive compounds *i.e.* phenols in contrast to other vegetables or legumes (Pedrosa *et al.*, 2020). Soy protein can lower LDL (bad cholesterol) levels and reduce coronary heart disease (CHD). It is an excellent source of essential fatty acids, calcium, magnesium, lecithin, riboflavin, thiamine, fiber, folate (folic acid), and iron (Dadwal *et al.*, 2018).

Soy flour is used as an ingredient in food, beverages, and spices, and provides the best health benefits. Soy can cause minor side effects such as bloating and nausea. Soybean seeds, like other soybeans, contain large amounts of all essential amino acids, minerals, phytates, and oxalates (Ganesan and Xu, 2017).

Protein malnutrition due to a grain-based diet is recognized worldwide as a major health problem (Farzana and Mohajan, 2015). To overcome the problem of malnutrition, different countries have experimented with different strategies, such as strengthening protein isolation and mixing different proteins from different sources (Butt and Rizwana, 2010).

Wheat flour is primarily employed for the development of various staple food derivatives around the globe meanwhile, certain foods are mainly deficient in nutrients such as essential minerals, vitamins, and bioactive compounds *i.e.*, phenolic along with flavonoids and antioxidants. The deficiency of such compounds may cause nutritional insecurities which may further initiate health-related disorders. These insecurities can be significantly reduced by introducing different legume blends *e.g.*, soybean, black gram, or green gram flour with wheat flour. Meanwhile, developed flour blends were examined for their biochemical, bioactive, and mineral profiles. Pulses are rich in protein, fiber, vitamins, and minerals, making them an excellent addition to diets. When combined with staple foods like wheat, they enhance nutritional quality by providing essential amino acids and increasing nutrient density, promoting better overall health.

Objectives

The primary objectives of this study are the following:

- Development of composite flour formulation
- Suitability and acceptability of composite flour

MATERIALS AND METHODS

***Procurement of raw material*:** The raw materials required for the study, including wheat, soybean, chickpea, black gram, and green gram seeds, were sourced from a local market in Multan. The grains were transferred into plastic bags, sealed for storage, and labeled for identification.

***Handling of raw material*:** The collected grains were cleaned to remove any foreign matter. They were then milled using a

lab-scale mill and passed through a 60mm sieve to produce homogenized flour particles suitable for dough development. The milled flour was stored in airtight glass jars to prevent moisture contamination.

Study Design: Five composite flour treatments were prepared by varying the proportions of wheat, soybean, green gram, black gram, and chickpea flours, as shown in Table 1.

Table 1. Treatments Plan (g/100g).

Treatments	T0	T_1	T_2	T_3	T_4
Wheat	100g	75.00g	50.0g	25.00g	0g
Soya bean	0g	6.25g	12.5g	18.75g	25g
Green gram	0g	6.25g	12.5g	18.75g	25g
Black gram	0g	6.25g	12.5g	18.75g	25g
Chickpea	0g	6.25g	12.5g	18.75g	25g

***Proximate chemical analysis*:**

Moisture content: Moisture content was determined by drying a 2g sample in an oven at 105°C for 3 hours (AOAC, 2010). The weight loss was calculated as the moisture content. Calculations:

$$Moisture\ content = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

***Ash content*:** Ash content was determined by incinerating a 2g sample in a muffle furnace at 550°C for 3 hours (AOAC, 2010). The residue was weighed to calculate the ash content.

Calculations:

$$Ash\ Content\ (\%) = \frac{W_2 - W_1}{Weight\ of\ sample} \times 100$$

***Crude Protein content*:** Protein content was determined using the Micro-Kjeldahl method, with total nitrogen quantified using a conversion factor of 6.25 (AOAC, 2010). The Nitrogen (%) content was calculated by the expression.

Calculations:

$$Nitrogen\ (\%) = \frac{V_s - V_B \times N_A \times 0.01401}{W} \times 100$$

100% Nitrogen in protein = Conversion factor

$$\frac{100}{16} = 6.25$$

***Crude Fat content*:** Fat content was determined using Soxhlet extraction with petroleum ether as the solvent (AOAC, 2010). Crude fat (%) was calculated from the weight difference after extraction and drying at 105°C.

Calculations:

$$Crude\ Fat\ (\%) = \frac{Mass\ of\ Fat}{Mass\ of\ Sample} \times 100$$

***Crude fiber analysis*:** Crude fiber content was analyzed by digestion with 1.25% H_2SO_4 and NaOH, followed by drying at 105°C and ashing at 550°C (AOAC, 2010). Fiber (%) was calculated from the weight difference before and after washing.

Calculations:

$$Crude\ Fiber\ (\%) = \frac{W_1 - W_2}{W_3} \times 100$$

***Carbohydrate contents*:** In this scientific venture, nitrogen-free extracts (NFE) were investigated in both prepared flours (wheat, soybean, chickpea, black and green gram) and developed composite flour treatments (T0, T1, T2, T3, and T4) according to the method prescribed by AOAC, (2010). The carbohydrate content was further measured as weight by a difference between 100 and the addition of other basic chemical attributes such as Nitrogen extract (NFE) percentage carbohydrate.

Calculations:

$$\%\ Carbohydrates\ (NFE) = 100 - (Fat + Protein + Moisture + Ash + Crude\ Fiber$$

***Mineral analysis*:**

***Sample preparation (digestion) & analysis*:** Wet digestion was used to remove organic biomass for assessing heavy metals. A 0.2 g sample was digested with 10 mL HNO_3 and 5 mL H_2SO_4 in a conical flask. A blank sample was prepared similarly without biomass. The mixture was heated at 80–90°C for 2 hours, then at 150°C until boiling. Additional HNO_3 (3 mL) and H_2SO_4 (5 mL) were added during digestion until a clear solution formed. The solution was cooled, filtered (Whatman No. 42), diluted to 50 mL with distilled water, and stored in labeled bottles for analysis. Heavy metals were analyzed using AAS, and results were reported in mg/kg (dry weight).

***Sample Extraction*:** Flours (wheat, soybean, chickpea, black, and green gram) and composite treatments (T0–T4) were ground into a fine powder (KMF grinder, 9676.8 gram) and stored at -40°C. For extraction, 0.5 g of dried sample was mixed with 100 mL ethyl acetate, stirred at 20°C for 3 hours, and stored in the dark for 12 hours. The mixture was centrifuged at 30°C for 9676.8 g, filtered through Whatman No. 1, and extracts were stored at 4°C for analysis (Fischer, 2011).

***Total phenolic content (TPC)*:** In this present study, prepared extracts were examined for their Total Phenolic Content by the Folin-Ciocalteu method as prescribed by Li *et al*., 2015. For this purpose, accurately 70 µL of prepared extracts were added in a test tube of 10 mL capacity followed by 250 µL of Folin- Ciocalteu reagent and 750 µL of NaCl2Co3 (1.9 M). However, a total volume of exactly, 5 milliliters was made up by adding distilled water and then mixed by using a Vortex mixer for about 1 minute before incubation for 2 hours in the dark. Consequently, the absorbance was measured by utilizing a Spectrophotometer (Thermo-Spectronic, Surrey, England) at 765 nm wavelength. The calibration curve was prepared by employing controlled solutions of Gallic acid. The obtained results were expressed as Gallic acid equivalents (GAE) in mg^{-g} dry solids.

***Statistical analysis*:** The Obtained data was analyzed by analysis of variance (ANOVA) through SPSS (Statistical Package for the Social Sciences). The Duncan's Multiple Range (LSD) test was utilized to determine the level of significance between the mean values obtained (Field *et al*., 2012).

RESULTS

The current research was planned and executed to fortify and enhance the consumer likeliness of composite flour. For this, raw materials (wheat flour, green gram flour, black gram flour, and soybean flour) were purchased from the local market of Multan. All the chemicals and reagents were made available in the laboratory of Food Science and Technology, MNS-University of Agriculture, Multan, Pakistan. The results/findings of current research work are under

***Compositional analysis of raw material*:** The compositional analysis of the raw material compromises moisture, ash, crude fat, crude fiber, crude protein, and nitrogen-free extract. The analysis of raw wheat flour revealed that it contained 12.11±0.03%, 0.75±0.02%, 11.16±0.04%, 0.73±0.02%, 0.88±0.03%, and 70.46±0.13% of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrates, respectively as shown in (Table 1). Raw green gram flour shows that it contained 8.86±0.07%, 3.22±0.03%, 21.83±0.03%, 1.73±0.04%, 6.46±0.03%, and 52.71±0.08% of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrates, respectively. Raw black gram flour shows that it contained 10.47±0.08%, 4.42±0.03%, 9.91±0.03%, 0.38±0.02%, 47.32±0.06%, and 26.57±0.03% of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrates, respectively. Raw soybean flour shows that it contained 6.81±0.05%, 4.01±0.06%, 34.67±0.26%, 17.73±0.32%, 5.87±0.15%, and 25.98±0.09% of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrates, respectively. Raw chickpea flour shows that it contained 10.94±0.05%, 2.73±0.03%, 22.92±0.03%, 3.98±0.05%, 4.02±0.03%, and 56.84±0.05% of moisture, ash, crude protein, crude fat, crude as shown in (Table 2).

Table 1. Physicochemical composition of raw wheat flour.

Parameter	% Value
Moisture	12.11±0.03
Ash	0.75±0.02
Protein	11.16±0.04
Fat	0.73±0.02
Fiber	0.88±0.03
Carbohydrates	70.46±0.13
Total phenolic contents	6.88±0.03

Table 2. Physicochemical composition of raw chickpea flour.

Parameter	% Value
Moisture	10.94±0.05
Ash	2.73±0.03
Protein	22.92±0.03
Fat	3.98±0.05
Fiber	4.02±0.03
Carbohydrates	56.84±0.05
Total phenolic contents	273.63±2.37

***Mineral composition of raw flours (mg/100g)*:** Mineral profiling of the flour measured by using the Flame photometer and atomic absorption spectrophotometer using the protocol illustrated in the AOAC, 2006. The details of the mineral profiles of the above-mentioned flours are as follows. The mineral composition of raw wheat flour shows that it contained 170.73±0.05, 4.87±0.03, 0.93±0.02, 0.65±0.02, and 0.10±0.01 of K, Na which can be measured through Flame photometer while Fe, Mn, and Cu was measured through atomic absorption spectrophotometer. Raw green gram flour shows that it contained 1438.67±1.45, 19.33±0.88, 11.30±0.01, 1.19±0.01, and 1.23±0.02 of K, Na which can be measured through Flame photometer while Fe, Mn, and Cu was measured through atomic absorption spectrophotometer. Raw black gram flour shows that it contained 301.13±0.59, 522.16±0.11, 10.41±0.01, 6.31±0.02, and 1.50±0.01 of K, Na which can be measured through Flame photometer while Fe, Mn, and Cu was measured through atomic absorption spectrophotometer (Table 3). Raw soybean flour shows that it contained 2.97±0.02, 5.10±0.07, and 0.61±0.02 of Na which can be measured through a Flame photometer while Fe and Mn were measured through atomic absorption spectrophotometer while K and Cu were not detected during the mineral analysis.

Table 3. Mineral composition of raw wheat flour.

Parameter	% Value
K	170.73±0.05
Na	4.87±0.03
Fe	0.93±0.02
Mn	0.65±0.02
Cu	0.10±0.01

Table 4. Mineral composition of raw black gram flour.

Parameter	% Value
K	301.13±0.59
Na	522.16±0.11
Fe	10.41±0.01
Mn	6.31±0.02
Cu	1.50±0.01

Table 5. Parameters for Atomic Absorption Spectroscopy (AAS) analysis

Sr.	Mineral	Wavelength (nm)	Lamp-Current (mA)	FF Rate (L/min)
1.	Na	589.0	9.0	2.0
2.	Ca	422.0	9.0	2.2
3.	Fe	510.0	9.0	2.2
4.	K	766.5	9.0	2.8
5.	P	830.0	9.0	2.0
6.	Mg	285.2	9.0	2.0

Na. Sodium; Ca. Calcium; Fe. Iron; K. Potassium; P. Phosphorus and Mg. Magnesium

***Development of composite flour*:** Different fractions of flour were mixed to prepare the nutritionally rich composite flour as described in Table 1.

***Product development*:** By following the method adopted and described by Haridas Rao *et al.* (1986), chapatis were made using the prepared composite flour.

***Physico-chemical analysis of product*:** The prepared product was further analyzed for its compositional values of moisture, ash, fat, protein, carbohydrates, fiber, mineral, and total phenolic contents using the methods illustrated in the AOAC (2000), AACC (2016), AOAC (2006), and Singleton *et al.* (1999).

***Moisture analysis (%)*:** The statistical values for the obtained moisture content resulting from the prepared chapatis with the composite flour give highly significant results. The treatment effect on the moisture percentage of chapatis shows the highest value in T2 with a mean value of 14.59±0.03 while the lowest value in T0 with a mean value of 28.87±0.03% as shown in (Fig 1).

The treatment effect on the ash percentage of chapatis shows the highest value in T2 with a mean value of 1.34±0.02 while the lowest value in T1 with a mean value of 0.97±0.03.

***Sensorial evaluation of composite flour chapatis*:** The statistical values for the obtained color value resulting from the prepared chapatis with the composite flour are non-significant. The treatment's effect on color values of chapatis shows the highest value in T0 with a mean value of 7.80±0.18 while the lowest value in T3 with a mean value of 7.40±0.12. The statistical values for the obtained aroma values resulting from the prepared chapatis with the composite flour give non-significant results. The treatment's effect on aroma values of chapatis shows the highest value in T2 with a mean value of 7.77±0.20 while the lowest value in T0 with a mean value of 7.23±0.09. The statistical values for the obtained taste values resulting from the prepared chapatis with the composite flour give non-significant results. The treatment's effect on taste values of chapatis shows the highest value in T2 with a mean value of 7.90±0.12 while the lowest value in T1 with a mean value of 7.57±0.12. The statistical values for the obtained texture values resulting from the prepared chapatis with the composite flour are non-significant.

The treatment's effect on texture values of chapatis shows the highest value in T4 with a mean value of 8.53±0.18 while the lowest value in T0 with a mean value of 7.17±0.20. The statistical values for the obtained foldability values resulting from the prepared chapatis with the composite flour are non-significant. The treatment's effect on foldability values of chapatis shows the highest value in T2 with a mean value of 7.90±0.12 while the lowest value in T4 with a mean value of 7.50±0.15. The statistical values for the obtained overall acceptability values resulting from the prepared chapatis with the composite flour are non-significant.

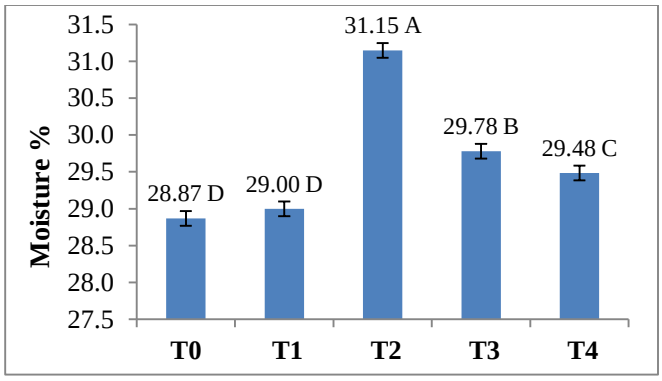

Figure 1. Moisture analysis of chapatis

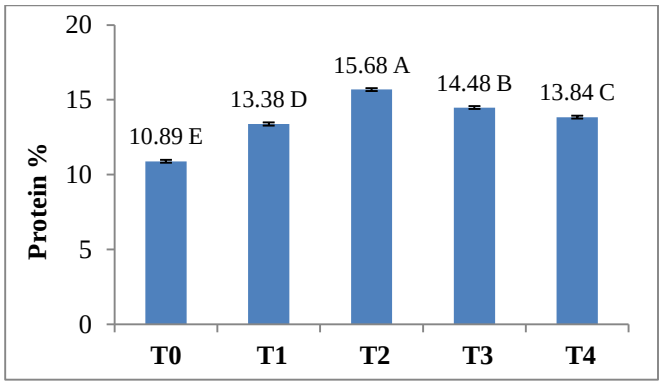

Figure 2. Protein analysis of chapatis

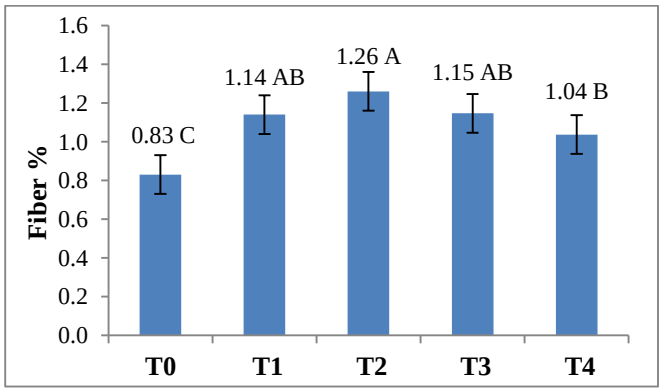

Figure 3. Fiber analysis of chapatsis

DISCUSSION

Carbonaro *et al.,* 2015, found similar results in their study while working on the mineral composition of soybean flour and found the range of Na 2.90-3.05%, Fe 4.95-5.25%, and Mn 0.55-0.70%. Raw chickpea flour shows that it contained 864.02±0.10, 111.16±0.09, 3.98±0.03, and 0.85±0.02 of K, Na which can be measured through Flame photometer while Fe and Cu were measured through atomic absorption spectrophotometer while the Mn cannot be detected during the mineral analysis.

The treatments effect on moisture percentage of chapatis shows the highest value observed in T2 with mean value of 14.59±0.03 while the lowest value was observed in T0 with a mean value of 28.87±0.03% as shown in (Fig: 1). The obtained results were found similar within the range of the findings of Cheng and Bhat, (2015) and Butt *et al.,* (2004). They also find the results in between the values of 28.80-31.20. The results/findings of current research work are under:

Okoye *et al.,* 2008, analysis of raw wheat flour found similar results in their study while working on the nutritional composition of wheat flour and found the range of moisture 10-12%, crude protein 10-12%, ash 0.7-0.75%, crude fiber 0.75-0.9% and crude fat 0.7-0.75% and carbohydrates 69-71%, respectively (Table 2).

Habibullah *et al.,* 2007, found similar results in their study while working on the nutritional composition of green gram flour. The proximate composition of raw black gram flour shows that it contained 10.47±0.08%, 4.42±0.03%, 9.91±0.03%, 0.38±0.02%, 47.32±0.06% and 26.57±0.03% of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrates, respectively. The proximate composition of raw soybean flour shows that it contained 6.81±0.05%, 4.01±0.06%, 34.67±0.26%, 17.73±0.32%, 5.87±0.15%, and 25.98±0.09% of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrates, respectively. Raw chickpea flour shows that it contained 10.94±0.05%, 2.73±0.03%, 22.92±0.03%, 3.98±0.05%, 4.02±0.03%, and 56.84±0.05% of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrates, respectively. Akinjayeju *et al.,* 2020, found similar results while working on wheat flour's mineral composition.

Habibullah *et al.,* 2007, found similar results in their study while working on the mineral composition of green gram flour. Raw black gram flour of K and Na shows can be measured through a Flame photometer while Fe, Mn, and Cu were measured through an atomic absorption spectrophotometer. Carbonaro *et al.,* 2015, found similar results in their study while working on the mineral composition of black gram flour.

Carbonaro *et al.,* 2015, found similar results in their study while working on the mineral composition of soybean flour. Raw chickpea flour shows that it contained 864.02±0.10, 111.16±0.09, 3.98±0.03, and 0.85±0.02 of K, Na which can be measured through Flame photometer while Fe and Cu were measured through atomic absorption spectrophotometer while the Mn cannot be detected during the mineral analysis. Dida Bulbula and Urga, (2018), found similar results in their study while working on the mineral composition of chickpea flour and found the range of K 860-865%, Na 109-112%, Fe 3.90-4.10%, and Cu 0.80-0.90%.

The obtained results were found similar within the range of the findings of Cheng and Bhat, (2015). They also find the results in between the values of ±0.90-1.40. The statistical values for the obtained protein content resulting from the prepared chapatis with the composite flour give highly significant results. Treatments had the greatest impact on the protein (%) of chapatis in which T2 had the highest with a mean value of 15.68±0.02, while T0 had the lowest, with a mean value of 10.89±0.03.

The obtained results were found similar within the range of the findings of Cheng and Bhat, (2015). They also find the results in between the values of ±10.85-15.70. The statistical values for the obtained fat content resulting from the prepared chapatis with the composite flour give highly significant results. The treatment effect on fat (%) of chapatis shows the highest value in T2 with a mean value of 2.24±0.06 while the lowest value in T1 with a mean value of 1.56±0.03. The obtained results in between the values of ±1.50-2.30. The statistical values for the obtained fiber content resulting from the prepared chapatis with the composite flour are highly significant. The treatment effect on fiber (%) of chapatis shows the highest value in T2 with a mean value of 1.26±0.01 while the lowest value in T0 with a mean value of 0.83±0.05 as shown in (Fig: 4.5).

The obtained results were found similar within the range of the findings of Panghal *et al.,* (2019). They also find the results in between the values of 0.80-1.30. The numerical values for the obtained carbohydrate content resulting from the prepared chapatis with the composite flour give highly significant results. The treatment effect on carbohydrates (%) of chapatis shows the highest value in T0 with a mean value of 54.91±0.03 while the lowest value in T2 with a mean value of 47.48±0.03. The obtained results were found similar within the range of the findings of Cheng and Bhat, (2015) and Butt *et al.,* (2004). They also find the results in between the values of ±47.45-54.95. The statistical values for the obtained total phenolic content resulting from the prepared chapatis with the composite flour give highly significant results. The treatment effect on the total phenolic content (%) of chapatis shows the highest value in T2 with a mean value of 5.95±0.02 while the lowest value in T1 with a mean value of 4.84±0.02. The obtained results were found similar within the range of the findings of Punia *et al.,* (2019). They also find the results in between the values of ±4.80-5.60. The statistical values for the obtained potassium content resulting from the prepared

chapatis with the composite flour give highly significant results. The treatment effects on potassium (%) of chapatis show the highest value in T2 with a mean value of 160.72±0.03 while the lowest value in T4 with a mean value of 157.64±0.04. The obtained results were found similar within the range of the findings of Cheng and Rajeev Bhat, (2015). They also find the results in between the values of ±155-162. The statistical values for the obtained sodium content resulting from the prepared chapatis with the composite flour give highly significant results. The treatment effect on sodium (%) of chapatis shows the highest value in T0 with a mean value of 3.25±0.02 while the lowest value in T4 with a mean value of 2.47±0.03. The obtained results in between the values of ±2.45-3.30. The statistical values for the obtained iron content resulting from the prepared chapatis with the composite flour give highly significant results. The treatment effect on iron (%) of chapatis shows the highest value in T0 with a mean value of 0.77±0.03 while the lowest value in T4 with a mean value of 0.46±0.02 as shown in (Fig: 4.10). The obtained results were found similar within the range of the findings of Panghal *et al*., (2019). They also find the results in between the values of 0.40±0.80. The statistical values for the obtained manganese content resulting from the prepared chapatis with the composite flour give significant results. The treatment effect on manganese (%) of chapatis shows the highest value in T3 with a mean value of 0.52±0.03 while the lowest value in T1 with a mean value of 0.32±0.02. The obtained results in between the values of ±0.30-0.55. The statistical values for the obtained copper content resulting from the prepared chapatis with the composite flour give highly significant results. The treatment effect on the copper percentage of chapatis shows the highest value in T3 with a mean value of 0.36±0.02 while the lowest value in T1 with a mean value of 0.14±0.02. The obtained results were found similar within the range of the findings of Panghal *et al.*, (2019). They also find the results in between the values of ±0.10-0.40.

***Conclusion*:** In addition to medicine, diet-based therapy is becoming a viable alternative for treating metabolic diseases in poor nations like Pakistan. In this current scientific venture different selected legumes *i.e.*, Soybean (*Glycine max*), Green gram (*Vigna radiata*), Black gram (*Vigna mungo*), Chickpea (*Cicer arietinum*), and Cereal grains such as wheat (*Triticum*) flour were analyzed for their proximate chemical analysis to determine the initial chemical profile and for the commencement of comparison between different legume and cereal grain flours. The proximate chemical profile of different selected legumes *i.e.*, soybean, green gram, black gram, and chickpea along with cereal grains such as wheat were analyzed.

In this study, wheat flour is partially substituted with selected legume flours to fulfill the nutritional deficiencies. Wheat flour is partially substituted with selected legume flours to fulfill the nutritional deficiencies. Pulse-supplemented wheat flour holds significant potential to combat malnutrition by enhancing the nutritional profile with increased protein, fiber, and essential micronutrients.

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